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II. *An Essay upon the Use of the Bile in the Animal Oeconomy, founded on an Observation of a Wound in the Gall-Bladder.* By Alexander Stuart, M. D. Physician to her Majesty, and F. R. S.

The Case of Mr. Menzies, Sergeant in the Second Troop of Horse-Grenadier Guards, wounded in the Gall-Bladder, with the Appearances in the Body after Death, and the Symptoms during Life; with some practical Inferences drawn from it.

HE was wounded about Three o'Clock in the Morning, the 30th of October, 1728, and died the 5th of November following in the Morning, being the seventh Day after he was wounded, in the fortieth Year of his Age.

Appearances in the Body, opened by Mr. *Coldham*, Surgeon, in the Presence of Messieurs *Fiquel* and *Black*, Surgeons, with several Gentlemen, and myself.

I. The *Abdomen* appeared distended as in a Tympany, or Ascites, and the Skin of the Belly tinged yellow as Saffron in many Places.

II. A triangular Wound appeared about two Inches on the right Side of the Navel, the Direction slanting upwards obliquely through the Integuments.

III. The Belly being opened, discovered the Wound to have penetrated through the *Peritonæum*, and the Sword had slanted upwards from thence along the *Omentum*, grazing slightly upon it, which was superficially ruffled, but so as to be hardly perceivable.

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IV. A small triangular Wound appeared in the Bottom of the *Gall-Bladder*, which had penetrated through the Membranes into its Cavity, but had no where wounded the Liver, nor any of the neighbouring Parts.

V. The *Gall-Bladder* was flaccid or collapsed, containing only a few Drops of Gall, which, by pressing the *Cystis* slightly, flowed out into the Cavity of the *Abdomen* through the Wound.

VI. The *Guts* throughout their whole Tract being distended, so as could be judged to triple the Extent of their natural Diameters, seemed to fill the whole Cavity of the *Abdomen*, so as to give the outward Appearance of a Tympany, or Ascites; which Distension disappeared, and the *Guts* collapsed, upon making several Punctures with a Lancet in their Sides, to give Vent to the Air.

VII. The rest of the Cavity of the *Abdomen*, which was not closely filled up by the distended *Guts*, contained a gross muddy Water, or Serum, intensely yellow, or highly tinged with Gall, to the Quantity of three Quarts, as I was able to guess without measuring it.

VIII. All the *Guts* and Contents of the *Abdomen* were highly tinged with this yellow Liquor, but no other Part of his Body, out of the Contact of this Liquor, had the least Appearance of it.

IX. No Inflammation appeared in any Part of the *Guts*, or in any of the *Viscera*, or Contents of the *Abdomen*, which were all found and healthy.

X. The Obliquity of the Wound through the *Integuments*, *Muscles* and *Peritoneum*, made it impossible

sible for the external Air to enter into the Cavity of the *Abdomen* that Way.

The Symptoms during Life.

I was called the 2d Day of November about Eleven o'Clock in the Forenoon, being the fourth Day after he received the Wound.

I. The Surgeons who had attended him from the Beginning, Messieurs *Fiquel*, *Coldham*, *Wilkie* and *Black*, being present, told me that his Belly had been distended, as I saw it, from the Beginning, giving the Appearance of a *Tympany*, or *Ascites*, and it continued at the same Pitch of Distension, neither diminished, nor sensibly encreased, to the Time of his Death.

II. No *Ructus* or *Flatus*, upwards or downwards, nor *Borborygmi*, notwithstanding this Distension of the Belly.

III. He never went once to Stool after he received the Wound, though pretty strong Purgatives and several Clysters had been given for the three Days before I came ; and though no Opiat (which might have been supposed to have retarded their Operation) had hitherto been exhibited : Neither had those Purgatives nor Clysters, which I ordered afterwards, the least Effect.

IV. He took what was thought a sufficient Quantity of Drink and liquid Food.

V. He never slept, or but very little, by short Slumbers, of about half an Hour, or an Hour at longest, and that very rarely, notwithstanding pretty large Doses of Opiats were given to procure Rest, after I came.

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VI. The Wound in the *Integuments* never digested in the usual Manner ; but looked flaccid, or flabby and pale, almost without Pus.

VII. The *Urine* in very small Quantity, at most two or three Spoonfuls at a time, clear but yellow, as if tinged slightly with Saffron, and without Sediment.

VIII. His *Pulse* was full, strong and even, but not quick.

IX. No feverish Heat to be felt in the *Skin*, on any Part of the Body.

X. His *Tongue* not hard, rough or black, as in a Fever, but of its natural Colour, with a silky Driness, and very little *Saliva*.

XI. He was not in the least delirious, from the Beginning to the Time of his Death.

XII. He had some slight Fits of the Hickup the second Day after I saw him, and some few Reachings to vomit ; some Interrmissions in his *Pulse*, sometimes one in 10, 15, 20, or 30 a Day before his Death.

In order to make some Use of this Case, it is necessary to premise, that as Reasoning without a Foundation in Facts and Experiments, does rarely lead to any Certainty in Natural Knowledge, so Observations of Facts and Experiments themselves, would be, in a great Measure, fruitless, if we did not endeavour, by Reasoning, to draw obvious, useful and practical Conclusions from them : In order to which, it must be observed, That the great *Apparatus* in the *Liver* and *Spleen*, two of the largest *Viscera* in the Body, confessedly designed for the Preparation and Secretion of the *Bile* ; and the Place of the *Intestines*, into which it is immediately deposited, afford indeed a strong Argument

gument for the universal Use of it in the Animal OEcconomy ; but do not directly point out what, or how many these Uses are, about which there has been a great Variety of Opinions.

But this singular Case, which must have happened very rarely, if ever before (wherein none of the Inwards, or *Viscera*, but the *Gall-Bladder* only was wounded, and by that Wound nothing but the *Gall* was lost or misplaced) by shewing how many Functions in the Animal OEcconomy were impaired or destroyed by the sole Loss or Want of it, does at the same Time point out or demonstrate the Use and Necessity of it towards Health, or the Perfection of these Functions ; and perhaps may lead to some Indications of Cure, in Cases wherein it is known to be deficient, faulty or redundant.

There was no other apparent or assignable Cause for these various Symptoms during his Life, of Death itself, and of those several Appearances in the Body dissected after Death, but this Wound in the *Gall-Bladder* : And as this Wound could not affect any of the Parts, nor produce these Symptoms in any other Sense than as it gave Vent to the *Gall* into the Cavity of the *Abdomen*, and deprived the Cavity of the *Intestines* and the *Blood* of it : Therefore from this Loss and Misplacing of the *Gall*, all these Symptoms and Appearances may justly be concluded to arise, and I think may be accounted for from that Cause in the following Manner.

I. The *Abdomen* was distended, as in a *Tympamy*, or *Acites*, from the Beginning, and the *Guts* appeared inflated to their utmost Diameters.

It is true, that this Inflation and Distension happens to most a few Hours before Death, and to all soon

after Death, and ariseth from the Spring, or Elater of the Air included, getting the better of its Antagonist Spring, or Elater of the muscular Fibres of the *Stomach* and *Guts*, which have no longer the Assistance of the *Blood* and *Spirits* to contract them, and keep up their peristaltic Motion. But the Inflation and Distension here spoken of, was several Days before Death, and, as I have been told, the very next Day after he received the Wound, though the *Pulse* was apparently strong and equal, and therefore a Defect of *Blood* and *Spirits* not to be suspected: And therefore it may be justly concluded, that the Influx of the *Gall* into the Cavity of the *Guts*, is as necessary to the Strength of their Contraction and Perfection of their peristaltic Motion, as that of the *Blood* and *Spirits* into their *Sides*; and that these three are the conjunct Causes of this Motion in Health, which would be defective by the total Want of any of them.

Hence we see that in Scyrrhositie of the *Liver*, where the Secretion, and therefore the Excretion of the *Bile* is more or less defective; and in the *Faundice*, where, by some Obstruction in the *Biliary Ducts* after Secretion, a Part of it is forced back, and regurgitates into the *Blood*, and very little of it is thrown into the *Guts*: I say, in those Cases we observe an uncommon Distension in the *Guts*, and Costiveness; which, if the Case proves incurable, terminates in an *Acites*, or *Dropfy*, in the Cavity of the Belly.

It may also be worth while to enquire, whether that which is commonly called an *Hysteric*, or nervous *Cholic*, generally attended with a lesser Degree of such like Distensions, with *Flatus's* and *Borborygmi*; I say, whether this Distemper, wherein the animal

imal Spirits are so much, and only accused, does not partly arise from a sluggish Secretion and Excretion of the *Bile*, occasioning a Defect in its Quantity; or from its Acrimony and great Viscosity, occasioned by its Stagnation in the *Gall-Bladder*; or from both these, as well as from a defective or unequal Distribution of the *Blood* and *Spirits* in the Parts affected. In confirmation of which, I have generally observed, that at some time or other in the Cure, a great Evacuation of porraceous viscid *Bile*, brought away either by Art or Nature, as well as a great Profusion of pale *Urine*, finished the Cure for that Time. The Vomiting of porraceous *Bile*, very common in such Cases, proves the same; and, I believe, it is generally allowed, that the ferruginous, porraceous and black Colour of the *Bile*, are owing to shorter or longer Stagnations of it, chiefly in the *Gall-Bladder*, which the sedentary Life of those who are subject to these Cholics, will sufficiently account for, even if there was no other Error in their Way of living; and whoever has observed the high yellow Colour and Contents of the *Urine* in a *Faundice*, arising from a Redundancy of *Bile* in the *Blood*, will readily acknowledge that an uncommon watery Palleness in the *Urine*, where no more than the usual Quantity of Fluids has been taken down to dilute it, does shew a Defect of *Bile* in the *Blood*; and I believe it is easy to account for the *Flatus's*, *Borborygmi*, Inversions of the peristaltic Motion, the *Pila Hysterica*, *Palpitations*, *Scotomia*, *Vertigo*, and other Symptoms of these Distempers, which are called Nervous and Hysteric, from the same Cause. And hence it is, that Bitters and Steel, known *Deobstruents* of the *Liver*, and *Correctors* of the *Bile*, with gentle Chologogues

in very small Doses, are of so much Use in such Cases ; though it be certainly true, that all strong Stimulating Purgatives are very hurtful and improper.

II. But to return to our Case, there was no *Ructus*'s or *Flatus*'s upwards or downwards, nor *Borborygmi*, notwithstanding this Distension of the *Belly* and Inflation of the *Guts*.

This, I think, shews very plainly that the *Guts* had lost all Motion, and were Paralytic by a total Want of *Bile* only, as much as if their Nerves had been totally obstructed : For had any Motion remained in them, whether the natural and regular peristaltic Motion, or a preternatural convulsive one, the Contraction of them either Way, would have propelled the contained Air from one Place to another, and would have occasioned *Borborygmi*, or would have expelled a Part of it upwards or downwards, when Nature had so much need of it to relieve the distended *Guts*, and Art had contributed to that Intention by Clysters and Purgatives given.

Which serves to illustrate what has been said above, concerning the defective and convulsive Motion of the *Guts* in Hysterick Cases, where, through a Defect in the Quantity or Quality of the *Bile*, or from both these, the Motion of the *Guts* becomes defective, irregular or convulsive, but is not totally lost through a total Want of it, as in this Case.

III. He never went to Stool after he received the Wound; and the strongest Purgatives and Clysters that could be reasonably given, had no Effect.

This seems also to be owing to the Want or total Loss of the peristaltic Motion; and plainly shews, that the strongest purging *Stimulus* has not the Power

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to restore it, without the Assistance of the *Gall*: For had it been in any Degree restored, the *Belly* would have fallen proportionally, and some Evacuation of what was lodged in the *Prima Via* would have followed.

If then the Power of Purgatives depends upon the Co-operation of the *Bile*, it will follow, that where it is most active or redundant, their Operation will be, *cæteris paribus*, greatest; and where it is unactive or deficient in Quantity, they will have proportionally a less Effect. Though it be true that a great Quantity, or morbid Acrimony of the *Bile*, by a too strong and violent Irritation, will bring the *Intestines* into such Spasms, as to stop all Excretion by Stool; and the strongest purging *Stimulus* added to it does only encrease the Spasms and Costiveness; as in *Bilious Cholicks*, which are always attended with exceeding Costiveness, not conquerable by the strongest Purgatives, if they be not joined with Opiats, to allay the Spasms, and obtund the Acrimony of the *Bile*.

He took what was thought a sufficient Quantity of liquid Food and Drink; but if the Elater of the *Guts*, and their peristaltic Motion were lost, it is easy to prove that none of his Food or Drink could enter the *Læteals* for want of the peristaltic Motion; and therefore that he died starved. And this will account for all the rest of the Symptoms mentioned.

To prove that this was his Case. All that have seen live Dissections, intended to shew the Nature of the peristaltic Motion, and the Course of the *Læteals*, must have observed, that the *Guts* have an alternate Systole and Diastole, or Contraction and Dilatation called the peristaltic Motion, the superior Section

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contracting itself, while the immediate inferior is dilated ; and this Motion is carried on in several Parts of the *Guts* at the same time ; and the contracting Part, by expelling the *Blood* and *Chyle* out of its Sides, in its Contraction looks pale, while the Parts dilated look florid, and the Vessels full of *Blood* and *Chyle*.

Now the Part contracting must necessarily force the *Chyle* from the grosser Parts of the Food or Aliments, towards the inner Surface of the *Guts*, where the perforated capillary Extremities of the *Lacteals* in the *villous Coat* are ready to admit, or rather to absorb it by Attraction, as far as the larger and visible Branches of the *Lacteals* on the Coats of the *Guts*, into which it easily flows in the Time of Dilatation, or *Diastole*, which expands and unfolds these Vessels at that Time for its easy Reception ; from which it is farther propelled by the next *Systole*, or Contraction, into the primary or first Order of the *Lacteals* in the *Mesentery* ; and by the same repeated Impulses of the contracting Sections of the *Guts*, is forced farther through the second Order of *Lacteals* in the *Mesentery*, into the *Receptaculum Commune*, and the *Thoracic Duct* ; assisted by Valves, and promoted by the incessant Motion of the *Muscles*, and of all the Contents of the *Abdomen* and *Thorax* in Respiration, it is at last poured into the *subclavian Vein*, for a perpetual Recruit of the *Blood* in a healthy State.

But if the first Movers in this Series fail, that is, if the muscular Fibres of the *Guts* have lost their peristaltic Motion, as in this Case, then the Expression, Absorption and Progress of the *Chyle* described, cannot succeed, the *Blood* must be deprived of its Recruit, and the Person die starved ; which, as I have said

said before, seems to have been this Person's Case, and will sufficiently account for the rest of the Symptoms above recited.

First, His Want of Sleep, and the Inability of *Opium* to procure it, might be owing to a Want of Recruit of *Chyle* in the *Blood*: As we see that those who live sparingly, sleep very little, and those who feed plentifully, require by so much a greater Number of Hours to sleep; and in all chronological Cases, where the Body ceaseth to be nourished, the Sleep also fails, and Opiats have but little Power; whereas in Children, where a great Part of their Food goes towards both Nourishment and Acretion, the greater Part of their Time is spent in Sleep.

It may indeed seem difficult to conceive how a Want of Rest should ensue so soon after the Accident. But considering that the Loss of one Meal in a Day, especially of Supper, to such as have been accustomed to sup, has occasioned fewer Hours Rest in the following Night, it will follow, that such Persons require at least some small Recruit once in six or seven Hours, in order to rest their usual Number of Hours; and therefore in our Case, where all Recruit must have ceased soon after the Accident, he might be sensible of the Impairment of Rest in six or seven Hours after it, and those about him might well observe the Encrease of that Symptom, at least in the following Night.

Another Difficulty ariseth from the Observation of *Swallows* and *Tortoises*, &c. who sleep most in Winter, when they eat and drink nothing. In answer to which, there seems to be no Parity between the natural Constitution of their Blood and Humours, and that of Men: To these, and such like Animals, with

regard to Recruit and Nourishment, Action and Rest, the Spring and Summer are as one Day, and the Winter as one Night; and their Blood and Humours seem to be fitted by God and Nature, not only to bear, but even to require such long Periods of Rest and Action. And probably there is as little Parity between the Crasis and Constitution of the Blood and Humours of a healthy Person, and of those in soporous and cataleptic Diseases, who are reported to have slept for Weeks or Months without Food of any kind: And therefore, I say, where the Crasis and Consistence of the *Blood* and *Spirits* are nearly the same, that is, *cæteris paribus*, he who feeds, and is nourished most, will sleep longest, & *e contra*.

The Position here advanced is farther confirmed by the Inefficacy of the Opiats given, they being capable of entering into the *Blood* through the Pores of the *Stomach* in Contact with them; by which quick Passage they have been observed to procure Rest soon after they have been applied outwardly, or taken down into the *Stomach*, as in this Case they may justly be supposed to have done: Though, for the Reasons above-mentioned, neither they nor any thing else could pass by the *Læteals*: But as the Aliments could not pass that Way, *viz.* by the Pores of the *Stomach*, nor by the *Læteals* into the *Blood*, there could be no Recruit nor Nourishment: And therefore the Opiats, though they did enter into the *Blood* by the Pores of the *Stomach* in Contact with them, could not procure Rest. Thus it would seem probable, that Opiats do produce their Effect by detaining the *Chyle* crude longer than usual in the Mass of *Blood*, and thereby lengthening Sleep beyond the usual Time; and

and that they are ineffectual where there is no *Chyle* in the *Blood* to be detained.

But to explain how *Opiats* do contribute to retain the *Chyle* and other Cruditie in the *Blood*, longer than usual, would require a Disquisition too tedious for this Place : But their Power of retarding or suppressing all or most of the Secretions and Excretions ; their palling or obtunding the Appetite ; their enabling one to fast long, and supporting one in Journies and Labour for a long Time without Food (Effects well known to the *Turks* and *Asiaticks* in their Journies through Deserts, &c.) these, I say, and some other known Effects of *Opium*, do very much favour this Opinion.

Secondly, The Want of *Pus* in the Wound was probably owing to a Want of Recruit of *Chyle* in the *Blood* ; and the Flabbiness and Paleness of its *Lips*, to a Shrinking of the Parts for want of daily Nourishment.

Thirdly, The small Quantity of *Urine* was probably also owing to a Want of Recruit of *Fluids* from the *Primæ Viæ* : For these, in a healthy State, find their Way to the *Urinary Passages* very soon. The slight Tincture of Yellow, which it had, must have been from the *Bile* spilt in the *Abdomen*, and filtrated through the Duplicature of the *Peritonæum*, and Bottom of the *Bladder* : For it could not be supposed to derive its Colour from the *Blood*, into which no *Bile* could now enter by the common Way.

Fourthly, The Want of *Saliva*, and the silky Dryness of the *Tongue*, seems to have been owing to the same Cause, a Want of Recruit of *Fluids* in the *Blood*, and a Loss of so much of them as fell into the *Abdomen*.

Fifthly, If it be supposed that such a small Wound through the *Integuments* and *Muscles* of the *Abdomen* and the *Peritonæum*, was capable of producing a *Fever*, then his not having any Symptoms of a *Fever*, must be owing to a total Defect of *Bile* and *Chyle* in the *Blood*, none of which could enter the *Læteals* for want of the peristaltic Motion, as has been said.

Lastly, The few Fits of Hickup, Reachings to vomit, and Intermissions in the *Pulse* in declining and dying Persons, seem to arise not only from a Defect, and therefore an unequal Distribution of the *Blood* and *Spirits*, but chiefly from the Corruption and irritating Acrimony of them, as the immediate Cause of Death in this and most other Cases. Which will be farther explained in the following Pages.

O B J E C T I O N I.

It may very reasonably be objected here, that the *Ductus Hepaticus* would carry a Sufficiency of *Bile*, for the Uses of the Animal *Œconomy*, into the Cavity of the *Intestines*, though none came by the *Ductus Cysticus*; and Nature seems to have provided the *Ductus Hepaticus* for this Purpose, that if any Obstruction or Defect should happen in any of these Secretory Channels, the Secretion and Excretion might go on for the Benefit of the *Œconomy*, in the other: As Nature has provided two Kidneys, and double Organs of Sense, for the same Reason. But the Effect will not be the same in a Wound, which is the Reverse of an Obstruction; because by a perpetual Evacuation through it, such a Revulsion and Derivation is made, as drains and desiccates all the neighbouring Parts, and either lessens

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or entirely frustrates the Secretion and Excretion by them : And this we find to be true, where the Secretory Organs and Ducts concerned in the different Secretions, lie at a great Distance from one another; as in the *Diabetes* we generally see a very great Desiccation of the *Salival Glands*, a Defect of *Saliva*, and a perpetual Thirst; and Sweating and Looseness lessen the Secretion by *Urine*; an *Issue* drains and emaciates the neighbouring Parts; and it is mechanically demonstrated by *Bellini*, that the Flux of the *Blood*, and of all the Humours, will be most and strongest towards the Part where the Resistance is taken off; as in Bleeding, to which this perpetual Flux of *Bile*, through the wounded *Gall-Bladder*, seems to have a great Affinity; and therefore would probably promote the Afflux of *Blood* and Secretion of the *Bile* so much and so strongly towards the *Vessels*, *Glands*, and *Secretory Ducts* leading to the *Cystis*, as very much to lessen, or totally to hinder the Secretion by the *Ductus Hepaticus* into the *Guts* by that Channel: And therefore, in this Case, the whole of this useful Juice seems for this Reason to have been totally lost to the Animal *Œconomy*.

O B J E C T I O N II.

Another Objection is, that as the *Guts* and other Contents, and even the *Muscles* and *Integuments* of the lower *Belly*, were highly tinged by the *Bile*, it is probable that some of it has got into the Cavity of the *Guts*, where it might, by its *Stimulus*, keep up the peristaltic Motion, and by the *Læteals* get into the *Blood*, for the Use of the Animal *Œconomy*; as

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it appears that some of it got into the *Bladder* in that Manner, and tinged the *Urine*.

It is not unlike that this might happen when the *Bile* came to be very redundant in the Cavity; but in passing through the Interstices of the *Vessels* and *Fibres* of the *Guts*, as through a *Filtre*, the grosser, saline and sulphurous Particles of it, which are the most pungent and active Parts, must have been left behind; which the muddy Thickness, as well as Deepness of the Colour of the Liquor found in the Cavity of the *Abdomen*, compared with the transparent Clearness of the *Urine* of a much lighter yellow Colour, without Sediment, does seem to prove: And it is not likely that such a small Quantity of filtrated *Bile*, as may be supposed to have passed that Way, deprived of all its active Particles, could either in Quantity or Quality be sufficient to assist in any Function of the Animal Oconomy, whether Natural, Vital or Animal: And, in Fact, if any passed that Way, it appeared plainly insufficient to promote the Contraction and peristaltic Motion of the *Guts*, which remained preternaturally distended, as has been said, from the Beginning to the Time of his Death.

O B J E C T I O N III.

It has been also objected, that an Animal which dies starved, dies delirious and feverish, the Experiment having been made on Cats and Dogs: And therefore this Person, who had no Fever, nor Delirium of any kind, cannot be supposed to have died starved.

I will not dispute these Facts, especially the Experiments upon Cats and Dogs, though I have not made any myself, nor do I remember to have had any just

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or accurate Account of the Symptoms of such who have died of Hunger and Thirst, in Sieges, and at Sea ; though many Instances have been, and no Notice, that I know of, has been taken of their having died mad, delirious or feverish, though these Symptoms are so remarkable and affecting. But supposing these Facts, these Cases will differ very much from this before us : For an Animal starved to Death purely for Want of Food, has the *Gall* flowing continually into the Cavity of the *Intestines*, unmixed and undiluted with *Chyle*, and from thence by the *Lacteals* into the *Blood* ; so that in a few Days this acrimonious Juice must become more redundant there, than any other Humour ; which joined with the constant Attrition of the Globules in Circulation, must soon render the *Blood* very acrimonious, rancid and alcalin ; that is, must reduce the whole to a Mass of Putrefaction, capable of stimulating the *Brain* and *Nerves*, so as to produce a Fever, Delirium or Madness : But in the Case under Consideration, no *Gall* could enter into the *Blood* : And therefore this Degree of Putrefaction, and the Effects of it, could not happen ; though it must be owned, that, through a Want of Recruit and Dilution, a lower Degree of Putrefaction of the *Blood* and *Humours* must have followed, even in this Case, from the continual Attrition in Circulation ; such at least as was sufficient to render the whole Mass in a few Days unfit for any of the Uses in the Animal Economy, or the Functions of Life : And therefore may be justly supposed to have been the immediate Cause of Death : For all the passive Principles or Materials of Putrefaction, being actually in the Substance of the *Blood*, and all the active Principles

bles of Heat and Attrition being at work upon it to produce this Effect, it could not fail to be brought about in a few Days; and the same would happen to all Animals, is what is effete, corrupted or altered, so as to be unfit for the Use of the Animal, was not continually carried off by the *Emunctories*, and a fresh Recruit daily supplied from the *Prima Viæ*; which Evacuations and Supply being kept up in their due Quantity and Proportion, do effectually prevent all Putrefaction and Acrimony, and keep the Blood and Humours in their natural Temperature, commonly (though mistakenly) called Sweetness.

It is not then a Defect in the Quantity of *Fluids* which kills an Animal in Fasting, but a poisonous Acrimony, which the *Blood* and *Humours* naturally contract, for want of a fresh Recruit and equal Evacuation. Thus in chronical Distempers, where the Person appears extenuated and exhausted, the Quantity of the *Fluids* is certainly very small, yet enough to maintain Life for some Months or Years, being kept in some Degree of Sweetness or proper Temperature, by a certain Proportion of Recruit and Evacuation: But where the Recruit is entirely substracted, the Evacuations will be proportionally lessened: And therefore the Quantity of *Fluids* may remain much the same, but the Quality will alter, and Putrefaction for the Reasons above assigned must take Place, and be the immediate Cause of Death, even long before the Mass of *Fluids* can be much diminished in Quantity, as in the Case before us. Which leads to the Answer of another Difficulty, *viz.*

OBJECTION IV.

How the *Pulse* should continue full, strong and equal for several Days, while the Person was in a starving Condition, and the *Blood* had no Recruit from the *Prima Via* ?

This indeed would be very unaccountable, if the Waste of the *Blood* and *Humours* were supposed to continue at the same Height as before the Accident, and the Evacuations by the *Emunctories* were the same as in perfect Health. In this manner the Contents of the *Blood-Vessels* would be soon wasted and exhausted : But *Santorius*'s Observations and Experiments do shew, that the daily Recruits and Evacuations keep Pace with one another, and are nearly equal in 24 Hours in a healthy State : And therefore where the Recruits are plentiful, the Evacuations will be equally so ; and where those are sparing the Evacuations are small ; or where the Balance is cast too much of either Side, some Indisposition or Distemper must follow. There is no Exception from this Rule, but in Children, a Part of whose Nourishment goes to Acretion, and the Increase of their Weight : Therefore in the Case before us, the Recruit being entirely subtracted, the Evacuations must have been little, or next to nothing : And therefore the Quantity of the *Blood* and circulating *Humours* would remain much the same, and keep up the Fulness, Strength and Equality of the *Pulse* for several Days, until the *critical Putrefaction* and *Colliquation* of the *Blood* above-mentioned, on the fifth or sixth Day, rendered it unfit for a regular Circulation, and produced Intermissions in the *Pulse*, Reachings to Vomit, and Hickup, all of them being local Convulsions, and

the Effects of Corruption, Acrimony, Irritation, and an unequal Distribution of the *Fluids*, which terminated in Death in the Beginning of the seventh Day.

The Sum of what has been said is, that in this Case very little, if any, *Bile* entered into the *Intestines*, and that ineffectual; and none at all into the *Blood*. And as there was no apparent Defect in any Part of the Body, nor any Wound that could have been either dangerous or deadly, in any other respect than as it gave Occasion to the Loss and Misplacing of the *Gall*; it is therefore evident, that all the Symptoms, and his Death, were entirely owing to the Loss of this useful Juice; which it seems is so necessary to all Parts of the Animal Oeconomy, Natural, Vital and Animal, that this Person could not live above six Days without it.

The practical Inferences that seem to flow by necessary Consequences from this Observation, are,

I. That the peristaltic Motion of the *Intestines* is as much owing to the Influx of the *Bile* into their *Cavity*, as to the Influx of the Animal *Spirits* and *Blood* into their *Sides*: And therefore that the *Bile* is to be looked upon as one of the prime Movers in the animal Oeconomy, by which the elastic Springs of the natural Motions, to wit, the *muscular Fibres* of the *Guts* are set to work; upon whose Motion all the subsequent vital and animal Motions do so far depend, that none of them can be long in Perfection where it is imperfect, nor subsist many Days where it is totally wanting.

II. This prime Motion is totally lost by a total Want of *Bile*; proves sluggish by a Defect in its Quantity; becomes irregular or convulsive by a great Redundancy

dundancy or morbid Acrimony of it. From whence several Distempers that are called *Nervous* may arise, and are more likely to be cured by correcting and eva-
cuating the redundant or faulty *Bile*, and disobstruct-
ing the *Liver*, than by most other Medicines taken
from the common Class of *Nervines*.

III. That the Power of Purgatives depends upon the Co-operation of the *Bile* : And therefore it is probable, that the Difference of Constitutions, at equal Ages, with respect to Purgatives, depends more upon the Quantity and Quality of the *Bile*, than on the Bulk or Weight of the *Body*, Quantity of the *Blood*, or other *circulating Humours*.

IV. It also appears that the Nourishment and Acre-
tion of the *Body* do in some Measure depend upon a
due Quantity and proper Quality of this Juice, with-
out which the *Blood* and *circulating Humours* could
not be recruited from the *Primaæ Væ* : And there-
fore that Defects in it may be frequently the Cause of
a *Marasmus*, or Waste of the *Body*, where it is little
suspected : Which may serve to point out the Method
of Cure in such Cases.

V. This Observation seems to lead to the Know-
ledge of the immediate Cause of natural Rest or Sleep
in a healthy State ; to wit, a certain Quantity or Pro-
portion of fresh *Chyle* in the *Blood* ; the Want of
which, from whatever Cause, will occasion Watchful-
ness, or some Degree of it. And this may serve to
point out the immediate Effect and Consequences of
Opiats, whence may be gathered how far, and in
what Cases they may be effectual and useful ; and in
what Circumstances they may be ineffectual, useless
or hurtful. Which may deserve a farther Illustration.

VI. That a due Quantity of *Aliments*, at proper Intervals of Time, is necessary to keep the *Blood* and *Humours* in their natural Temperature and Sweetness, and to preserve them from Acrimony and Putrefaction: And this will be true in all Distempers as well as in Health, and is against the Practice of such as pretend to starve away Distempers, or to deny a due Quantity of Drink and liquid Food to the Sick, especially in Fevers, where the Want of this Recruit will tend to encrease the Acrimony or Putrefaction, whence the Malignity of most Fevers does arise.

VII. That *Pus*, or Matter in a Wound or Ulcer is the Product of *Chyle*, and not of the *Blood* or *Serum*: Which has indeed been the received Opinion, though supported by no other Proof than the Similitude of *Pus* to *Chyle*. And as a great Redundancy, as well as a Defect of *Pus*, does sometimes retard the Cure of a Wound or Ulcer, this may serve to shew by what Means it may be encreased or diminished, to answer the Intentions of the Artist.

This also makes it appear probable, that a great Redundancy of *Chyle* disposeth the Body to purulent, suppuratory and scrophulous Distempers; and seems to indicate the subtracting such Sorts of Food as afford a rich, gross or plentiful *Chyle*, and the administering of such Medicines as may strengthen Sanguification, and the other assimulating Powers, to assimilate and thereby consume it; the Sanguification and assimulating Powers being manifestly weak, as the Chylification seems to be strong in all such Cases. And this seems to be the Reason why in *Adults*, as the Sanguification grows stronger, and in *Age*, as the Voraciousness of the *Appetite*, too common in

Youth, declines, these Distempers do often decrease, and at last wear out of themselves: Which shews what Assistances Art ought to contribute, to bring about the same Effect in a less Time.

I must here own my Omission to open the *Stomach* and *Guts*, in order to view the State of their Contents, where the *Gall* was entirely wanting, which might have given some Light to this Observation. This Omission happened through some Hurry at the Time, which I regret; but am apt to believe, that as most of his *Aliments* were Liquids, the Alterations would not have been very conspicuous or obvious to the Sight. And I hope it will not be impracticable to make some Experiments on live *Animals* for this Purpose, with more Care and Attention, for supplying what may have been defective in this Observation.

III. *Observatio Lunaris Eclipseos, Ulissipone habita die 2 Februarii, An. 1730, N. S. in Collegio Divi Antonii magni à Rev. P. Joanne Baptista Carbone, Soc. Jes. Ex ejusdem Cl. Viri Epistola ad Jacobum de Castro Sarmento, M. D. Coll. Med. Lond. Lic. & R. S. S.*

Temp. Ver. P. M.

H. " "

13	25	o	Incipit penumbra sensibilis.
	40	o	Fit spissior.
	58	o	Fit spississima.

Dubi-